



ICT INDUSTRY IN ARMENIA: CURRENT STATE AND DEVELOPMENT PATTERNS

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Abstract: The paper focuses on the current state and development trends of ICT industry in Armenia. It analyzes government actions initiated during last decade to support the ICT sector as reflected in adopted policy documents and initiatives.

Keywords: ICT industry, S&T and innovation policy, Armenia

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INTRODUCTION

Nowadays Information and Communication Technologies (ICT) have an enormously important role to play in building the social capability to generate information and to apply knowledge for sustainable development.

The emergence of new capabilities is closely linked to the progress of scientific and technical innovation. Scientific discoveries and technological innovations in ICTs are moving at a pace and with impacts that are unprecedented. Those with access to these innovations – and those who have the capacity to absorb them and use them – will have opportunities to reap social and economic advantages. Those without access and the appropriate capabilities risk being marginalized in the “knowledge societies” of the future (Information Technology for Sustainable Development 1998).

Although the Armenian innovation system faces serious challenges, some positive tendencies are being observed during last years. In particular, this refers to the IT sector, which began developing rapidly in the late 1990s from the country’s considerable existing potential accumulated during the Soviet period, when Armenia was a leading centre for R&D and production in the areas of computer science and electronics. Presently, the IT industry is one of the most dynamic and promising sectors of the economy with around \$84 million in total revenues in 2006,

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representing 1.3% of Armenia's GDP, which is comparable to that of India (1.4%) and Germany (1.3%). In recent years the sector has witnessed major inflows of foreign direct investments and around 63% of the industry's output is exported to over 20 countries, but mainly the USA, EU, and CIS (The Guide to the Armenian Information Technology Companies 2006).

In this paper we will try to give an overview of current state of ICT industry and its development patterns in Armenia during last years with focus on analysis of government actions and initiatives to support the process.

CURRENT STATE OF ICT INDUSTRY AND DEVELOPMENT PATTERNS

The Information Technologies (IT) industry is one of the most successful and fast-growing sectors in Armenia. Its history goes back to the mid 1950s when several major RTD and semiconductor manufacturing companies were established, which concentrated on industrial and military applications. One of leading such R&D institutes was Yerevan Scientific Research Institute of Mathematical Machines, which employed around 10,000 people by the mid 1980s, more than twice the size of the whole IT workforce today. Another major research institute, Institute for Informatics and Automation Problems, was created in 1957 as part of the National Academy of Sciences. Research was also carried out in major universities and branch institutions. A number of production companies were established during that period oriented towards R&D and manufacturing of electronics and semiconductor devices (The Guide to the Armenian Information Technology Companies 2006).

After the break up of the USSR, this industrial potential and highly qualified workforce played a crucial role in revival of the sector in the mid 1990s, which enabled entrepreneurs and investors to start new business ventures in the fields of high-tech and IT.

The industry received a new impetus starting from around 1997, stemming from the successes of previously established companies, general revival of the economy, and unprecedented growth of the IT sector worldwide. The industry started offering higher paying jobs to the young generation encouraging them to pursue careers in the technology fields.

During the last 8 years, the industry saw a sharp increase in the number of new local start-ups and branches of foreign companies. More than 90% of foreign companies were established within 1998-2006. In 2006, the number of foreign companies in Armenia reached nearly 50 entities or 30% from the industry total. Share of foreign branches increased by 8% from 22% in 2003. Armenia's expertise in software development has been gaining more and more recognition outside the country thus fostering foreign direct investments. Compared to 2003, percentage of firms with Russian/CIS ownership decreased by 9% stressing the fact that very few software businesses have recently been formed with CIS investments. On the other hand, more companies with European ownership were established during the last 3 years leading to a larger share of EU firms, which increased from 17% to 23%. Still the majority of foreign branches are from the USA: almost 70% of overseas firms have North American ownership.

Presently, the IT sector produces nearly 10% of Armenia's export and almost 2% of the GDP. The sector is comprised of, by various estimates, around 160 indigenous and foreign companies employing around 4,700 people and generating around 85 million

USD annually. The IT industry has been growing at a compound annual growth rate of 20% in the last 10 years.

During recent years, a number of foreign companies established its presence in Armenia. In 2000, U.S. based Leda Systems Inc. started its branch in Armenia. One of the key initiatives of the company was the creation of a specialised training centre in cooperation with State Engineering University of Armenia, where students have an opportunity to receive high-quality engineering practice in the design of integrated circuits, related software and components. This is an example of successful industry-university cooperation. Students graduating from the university are employed by the company.

Armenia's considerable expertise in the field of chip design attracted Synopsys Inc., a global leader in EDA and VLSI design. Currently, it is the largest software company in Armenia employing more than 400 professionals.

Other major international brands as Alcatel, Siemens AG, Microsoft Corporation, and Sun Microsystems Inc. operate representative offices in Armenia and are involved in various industry specific and educational initiatives.

The IT sector has a great potential for further growth owing to presence of well-educated and talented workforce with high degree of technical skills, highly competitive labour cost, strong university programmes in computer and related sciences, and strong Armenian Diaspora in Western Europe and North America. Though, in all cases a strong and vigorous government support is crucial and needed for creating most favourable conditions for further development.

Growing importance of IT industry led the Armenian government to declare ICT as one of the priority sectors of Armenian economy in 2000. Other key policy initiatives include preparation of Armenia's ICT Master Strategy and creation of Information Technologies Development Support Council in 2001.

The ICT Master Strategy states that the transition from manufacturing economies to knowledge economies offers new opportunities for Armenia. Wealth in the 21st century will accrue to those who implement "knowledge based infrastructure". Armenia's potential to succeed is great, but it relies on the country's ability to leverage human capital and to retain its knowledge assets, not export them. To do so, the Armenian information and communication technology industry must:

- Pursue an aggressive niche strategy in global industry as opposed to a broad-based generic strategy that simply focuses on a low cost advantage
- Undertake a "grassroots" evolution that is bottom-up and market-driven, as opposed to top-down, government directed development
- Enhance existing and develop new "smart infrastructures" that help create an innovative, creative, and attractive environment that is conducive to retaining old and drawing new ICT knowledge workers for a globally competitive ICT sector
- Create a model that keeps existing and new ICT professionals in the country by empowering them, improving their quality of life, and accelerating their productivity to the benefit of Armenia

The vision of this Master Strategy is the creation of an industry that promotes the wide use and application of information technology by Armenian citizens, businesses, and government to improve the quality of life and advance every facet of the Armenian society including homes, businesses, schools, and the community.

The ICT Master Strategy mentions creation of an innovation system as one of its strategic aims. It states that maintaining a flow of talent, management, technical

support, and new ideas is essential to sustaining a vibrant IT sector over time. In order to maximize the sector's potential, it states that an environment must be developed and nurtured that provides a visible path for scientists, educators, entrepreneurs, and talented managers and experts to follow to realize their ideas. This requires a partnership between government, education, private enterprise, donors, non-profit organizations, and business leaders. A system must be supported and coordinated that provides incentives and visibility for innovative approaches and new ideas from the laboratories through education, management, and commercialization of technology to government operations.

The document stresses that many of the components of the system are already developing in Armenia, such as new approaches to education, business development, government e-commerce projects, technology commercialization, and new support organizations. The challenge is to coordinate these programs toward a common goal and visibility. The strength of the future IT industry in Armenia will depend on the quality of innovation activity in the country, including advanced academic work and commercialization processes to utilize the knowledge created in products and services.

In developing this strategy, recommendations are based on five underlying necessities: 1) the core capabilities derived from this strategy will reside in Armenia; 2) the primary outcome will be growth and wealth creation; 3) quality of life and social factors will be a national priority; 4) the goals and objectives of this plan must be challenging but attainable, consistent with the environment in Armenia; and 5) the strategy must achieve cross-sector collaboration. Specifically, how effectively Armenian businesses, academic, and government sectors collaborate and cooperate will, in large part, determine Armenia's ability to create high value jobs and to accelerate economic growth while improving the quality of life.

Based on the premise that a niche must be enhanced and sustained, the Master Strategy identifies key goals and proposes a course of action that creates the proper conditions for positioning the Armenian ICT industry at global levels. The goals of this Master Strategy are to accelerate the momentum and growth of the ICT industry already underway, create a vibrant and sustainable ICT industry, and provide a long-term methodology and successful model to develop other industries in Armenia. The Master Strategy seeks to strengthen Armenia's existing business base while transitioning to more sophisticated, higher value business opportunities that promote innovation and entrepreneurship, create more wealth in Armenia, and improve the country's quality of life to ensure long-term business success.

The Master Strategy strives to foster entrepreneurship to develop and sustain ICT business clusters utilizing skilled people, knowledge institutions, knowledge networks, and information and communication infrastructure. Its aim will be to create the infrastructure and environment that nurtures entrepreneurs and creates the networks of support, both domestically and internationally, that attract capital and expertise needed to sustain an entrepreneurial environment that promotes growth throughout the country (ICT Master Strategy for Republic of Armenia 2001).

The Master Strategy outlined 18 strategic directions which included activities towards developing human and business capital, improving legal and regulatory environment, facilitating accessible and affordable telecommunications services, enhancing government services through use of ICTs, developing external and internal angel and venture capital funds and establishing an investment friendly environment, promoting collaborative effort between large and small business, government, non-profit associations and venture capital through creating global networks to link to best

practice elsewhere and developing innovative culture, support to advanced academic work and commercialization processes, and encourage university linkages with firms to develop new products and services, creating regional leadership initiatives, prioritizing research and science and other activities directed to creating the proper conditions for positioning the Armenian ICT industry at global levels.

Meanwhile, it should be mentioned that many of the strategic directions outlined in the document remained on paper and unrealized which prioritizes adequate implementation of adopted policy documents. Some of the stated measures have been implemented via the Enterprise Incubator Project but, in general, the enforcement level remains poor. Moreover, certain steps of the government come to contradiction to stated strategic development actions envisaged in the document.

Thus, the government's decision to grant a legal monopoly to a telecommunications company owned by a foreign investor in the mid 1990s has led to very high costs and to a greatly lowered quality of service in this key economic activity. The cost of using the Internet in Armenia was 41 percent higher than the average for the CIS (2006). The prices charged for high-speed connections are 30 times those of countries with competition in telecommunications. Armenia has extremely low number of Internet users, well below the CIS average (The Caucasian Tiger: Sustaining Economic Growth in Armenia 2007).

Such a situation in the information technology infrastructure can be considered as serious barrier to the development of the industry and the economy as a whole.

In this sense a stronger and more tailor-made government support is crucial and needed for ensuring further development of the sector.

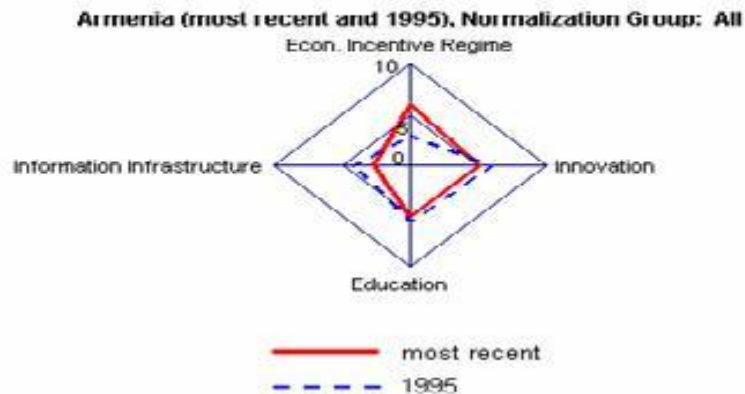
Studies and recent analysis carried out by World Bank experts are indicative that Armenian IT companies have not been able to take full advantage of the recent change in the ICT sector worldwide. They have successfully entered software and imaging technology niches, but they have failed to enter other stages of the production and delivery process – in particular as providers of front-end customer contact/support services or suppliers of components. The incorporation of local producers into the international production and marketing networks and the supply of ICT consumer services usually bring new technologies and managerial skills, as well as direct access to larger markets. It boosts exports without the need for local firms to incur marketing expenses and provides greater stability thanks to the global reach of a “parent” company.

The stated high growth rates may be difficult to sustain also due to a still major shortage of qualified developers, engineers, and project managers. So far, size of the workforce has been one of the primary factors limiting industry growth. Apparently, shortage of specialists will keep its priority at least until the end of the decade.

Among other factors hindering further development of IT sector in Armenia it can be mentioned general fiscal policy and significant appreciation of Armenian currency during last years. The policy challenge lies in building on the strengths of the country and addressing the critical weaknesses so that growth at higher productivity levels can be ensured.

To our mind, it will be also interesting to view the relative performance of Armenia in the Knowledge Economy Index (KEI), a composite index which measures the preparedness of the country for a knowledge-based development framework (The Caucasian Tiger: Sustaining Economic Growth in Armenia 2007). The KEI is calculated by computing the average of the performance scores of a country or region in all four pillars of the KE which are Economic Incentive Regime, Education, Innovation and Information Infrastructure.

Figure 1: Armenia: Performance in the Four Knowledge Economy Pillars, 1995-Most Recent



Source: Knowledge Assessment Methodology (KAM), Knowledge for Development Program, World Bank Institute (WBI), World Bank (www.worldbank.org/kam).

On the overall knowledge economy score, Armenia is among the coping economies: within the same league as Russia, Ukraine and Costa Rica and within a healthy distance from both laggards and entry level economies.

Yet Armenia's performance across the four pillars is unusually unbalanced. On economic and institutional regime Armenia performs very well, on a par with recent EU entrants. In contrast, the ICT pillar is shockingly underdeveloped. Not only is Armenia squarely among laggards (the worst category, occupied by Sub-Saharan Africa, Albania and the Central Asian republics of the FSU); its relative position has actually worsened quite significantly since 1995. This is all the more worrisome given its geographical isolation. In absolute terms Armenia did improve its ICT indicators but the world on average (defined by the 121 countries in the KAM sample) made a significantly larger improvement. ICT is the country's weakest pillar. In absolute terms, however, some improvements in Internet usage and computer penetration ratios were achieved, but the volume of these improvements was much less significant than those occurring globally. In Armenia the current levels of Internet users per 10,000 people and computers available per 1,000 people are among the lowest in the region and globally. The availability of telephones and mobile phones per 1,000 people is also very limited—an additional element indicating the profound weaknesses and state of emergency in the telecommunications infrastructure of the country. The gap in performance between Armenia and its selected comparators is tremendous and is apparently widening. Because of its landlocked status and unfriendly neighbors it should have at least accession club ranking on ICT. But what is the difference of ICT development patterns of Armenia to those, for instance, of East Asian "Tigers"? By the 1990s more than a quarter of all exports from the Republic of Korea, Taiwan, and Singapore were classified as "ICT equipment" that is, telecommunication equipment, computers, office machinery, electronic goods

and components. Since this category of equipment has a growth rate twice as high as commodity trade in general, it is clear that countries with an export structure of this kind are likely to perform fairly well in international trade (Mansell and When 1998). In case of Armenia the largest revenue contributing segment of ICT industry is customized development (around 22% of the total), followed by chip design activities (around 16%) and ISPs, networking systems and communications and internet applications. As we see, these are mainly software products which are exported and applied in parent companies abroad. In this sense, with increasing workforce cost and shortage of high-quality specialists the future growth prospects of Armenian ICT industry seem to be problematic and need to be adequately addressed through promoting local production of ICT equipment and/or components the potential for which still exists.

Finland, Ireland, and Korea are the best-known, best-practice exemplars of concerted action – countries that have engineered successful transitions to knowledge-based economies. In all of these cases, national economic crises compelled diverse actors to define and implement a new agenda through explicit or implicit national agreements on goals and mechanisms to move forward. The crises also prompted policymakers and private sector leaders to lengthen the time horizon of the policies adopted. Thus, Nokia – Finland's first mover toward an innovation-based economy – dramatically increased R&D investments. Finland responded by increasing public R&D and transforming the innovation system to fit business needs. Members of Parliament took courses and went on study tours demonstrating the need for the new agenda. National public innovation organizations played a crucial role, by transforming technology into businesses and assuring a critical mass of demonstration cases.

Ireland also exemplifies a successful combination of top-down and bottom-up policies. It made an investment in education and R&D infrastructure in the 1980s, followed by drastic policy changes beginning in 1987. To complement its top-down policies, Ireland instituted pragmatic bottom-up programs – regional partnerships to mitigate high unemployment and a program to expand national-supplier linkages from FDI. South Korea's powerful and shared national vision—from which impetus a private sector champion emerged—was followed by effective government coordination (The Caucasian Tiger: Sustaining Economic Growth in Armenia 2007).

In Armenia we can't see such a systemic approach and tailor-made consistent measures in developing national and sectoral innovation systems.

Amongst the most successful state and private sector-specific initiatives of recent years it can be mentioned the establishment of Enterprise Incubator Foundation in 2002 by the government and the World Bank within \$5 million learning and innovation loan, to support development of IT industry, which was the largest IT industry support initiative in Armenia. The project's overall objective was to pilot innovative private-public mechanisms for providing business development services to nascent enterprises, and continuous education and training to professionals in the field of ICT.

Enterprise Incubator provides a comprehensive package of services via its two major components:

Business Services component focuses on assisting Armenian technology firms in a variety of areas including business development, marketing and promotion, management, accounting and finance, legal, and other areas vital to the success of a company. The Business Services unit helps existing companies in growing their businesses within Armenia and internationally, facilitates the development of start

ups, and assists local entrepreneurs in building their ideas into successful businesses. As part of their assistance, EIF helps companies to improve the professional and business skills of the employees and managers via provision of short-term advanced trainings and seminars and creation of learning partnerships within the industry and the universities.

Facility Services component provides high-end facilities to existing technology companies and newly created start-ups. Options included in the base package are high-quality office space, shared meeting and conference rooms, shared resource centre with access to literature and other information resources, high-speed Internet connection, receptionist and security, cleaning and utilities, parking, and 24/7 access to the building.

The EIF Board of Trustees assessed the EI project implementation as highly satisfactory and meeting all the objectives put at the core of the Learning and Innovation program. It provided unmatched help to the development and promotion of the Armenian IT industry and received substantial awareness and support within the IT sector, the Government, and the development community. The project brought learning and innovation business development mechanisms and instruments as well as best expertise to the Armenian IT sector.

The project - the first of its kind in Armenia - introduced venture funding and start-up development mechanisms to the country and succeeded in attracting foreign direct investment through the initiation of global investment programs with international corporations such as Sun Microsystems, Alcatel, Microsoft, HP and others.

According to the project's final evaluation - conducted by an independent audit organization - of achievement of the project development objectives, Enterprise Incubator Project (EIP) met or exceeded all of its objectives (based on initially established key quantitative indicators). At the appraisal the total number of IT enterprises the Bank and the Borrower expected to benefit from the project was about 50. In fact, the project far surpassed this initial estimation of the client base, providing consulting services and/or training to 109 IT companies in Armenia, or about 73 percent of IT companies currently active in the sector.

Similarly, another objective of the project was to increase business linkages with foreign companies. The EIP resulted in 20 sales/outsourcing contracts, exceeding the target of 14.

The EI Project resulted in the creation of a self-sufficient foundation capable of sustaining its activities beyond the project completion and continuing support programmes for IT sector in the country, and, according to its director, has been chosen as a good-practice example for implementation in other developing countries.

Conclusions

The experience of developed nations shows that innovation activity and science-intensive productions are real, rapidly developing and effective branches of economy, which can have an immense impact on other branches of economy.

It is obvious that in the country with scarce mineral resources and transportation restrictions, as Armenia, development of innovative entrepreneurship, in general, and in the field of ICTs, in particular, will enable to involve considerable S&T potential of the country in the processes of market reformation and economic revival. Here the

main coordinating role belongs to the state, so as despite R&D, emergence of innovation and its dissemination also depends on other interconnected factors, as, for instance, national education and scientific systems and their cooperation, interlink between companies, producers and consumers, existence of adequate financing organizations, labor market, and others. This role of the government can be achieved through development of long-term and short-term strategic development programmes based on objective analysis of the situation and assessment of available resources, and its persistent and adequate enforcement. In case of Armenia there is a well-developed Master Strategy on development of ICT industry but the implementation process remains to be poor. This prioritizes adequate enforcement of adopted policy documents with strong government commitment and financial allocations for implementation of tailor-made programmes to tackle identified bottlenecks.

At the same time the whole innovation system in Armenia can be characterized as quite fragmented with very weak linkages among the productive sector, the universities and the research institutes, and this is not an exception for the ICT sector as well. There is strong need for developing incentives and mechanisms for better linking and collaboration between academic and university R&D and ICT industry, and commercialization of research outcomes via special collaborative programmes, may be, on co-funding basis considering scarce budget resources.

Armenian ICT companies have successfully entered software and imaging technology niches, but they have failed to enter other more added-value stages of the production and delivery process – in particular as providers of front-end customer services or suppliers of components. There is a need for further incorporation of local producers into the international production and marketing networks and the supply of ICT consumer services which will enable to bring new technologies and managerial skills to the country, as well as acquire direct access to larger markets.

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